

## Project Outline: Rainwater harvesting project Gracias a Dios, San Jacinto



Submitted by: Nuevas Esperanzas UK  
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### *Background*

The origins of this project date back to 2003 when the predecessor of Nuevas Esperanzas, Mercy Ships Nicaragua was contacted by Olive Branch Mennonite Missions (OBMM) about a potential water project for the community of Gracias a Dios, San Jacinto. OBMM had built houses in Gracias a Dios following Hurricane Mitch and subsequently raised funds to provide a water supply to this community. Their proposal was to drill a well, following the recommendation of an earlier hydrogeological study of which the community had a copy. A quotation was obtained from a drilling contractor for the well of approximately US\$20,000, a large sum due to its depth and potential complications. This amount was only for the well and did not include any other infrastructure. Mercy Ships Nicaragua was asked for technical advice and to comment on the viability of the proposal.

In reviewing the technical assessment of the water situation in San Jacinto, it became apparent that there had been a long history of investigations and proposals for potential projects. Amongst others CARE had a long standing interest in a water project in the area and had presented proposals of their own for a solution involving pumping water from a proposed borehole a considerable distance away from the community. Previous studies disagreed about the viability of drilling in the area proposed by the community, which is a highly active geothermal field, as evidenced by San Jacinto's famous volcanic fumaroles. Much more data was available than had previously been taken into consideration and there are many previously drilled wells in the area that have encountered problems with thermal or contaminated water. In the light of the uncertainty of the viability of the proposal, OBMM were advised by Mercy Ships Nicaragua not to go ahead with the proposed drilling project which was considered to have a high risk of failure.

Mercy Ships Nicaragua then undertook their own study to evaluate possible solutions. This study included a participatory appraisal with the community, and the introduction of the concept of rainwater harvesting. The idea in Mercy Ships Nicaragua's approach was to look for possible solutions that were more accessible to the community. It is questionable whether the community would be able to afford the operating costs of treating the volcanically contaminated groundwater or of pumping water of better quality from a different area, even if 100% of the capital costs were covered by donors. Collection of rainwater is a sustainable, environmentally friendly, relatively simple and cost-effective solution for communities like San Jacinto, with relatively good pre-existing roof structures. The climate of this area is such that plentiful supplies of rainwater could be collected and stored during the wet season. There was very limited awareness within the community of the range of technologies that can be used for rainwater harvesting and the potential benefits that it could bring to the community. Mercy Ships Nicaragua prepared a proposal for a nine month pilot project to introduce these concepts which also included environmental and health promotion components. As OBMM had raised funds for a solution to the problems at Gracias a Dios, Mercy Ships Nicaragua advised that these funds should be retained awaiting the outcome of the pilot project and of an alternative proposal for a piped water supply.



▲ Gutters from both sides of this corrugated iron roof channel rainwater into this 31,000 litre tank. The roof of the tank protects the water supply from contamination and prevents mosquitoes from breeding.



▲ A completed 27,000 litre water tank with domed roof and tap station. The smaller valve at a higher level draws water for domestic use. The larger valve at a lower level drains the tank completely for cleaning purposes.



▲ Water at last! Luvy Vallejos, a very happy resident fills a bucket with clear water from her tank.

In January 2005, Mercy Ships Nicaragua began an integrated rainwater harvesting, health promotion and environmental stewardship project in San Jacinto having received a grant of \$40,000 from a Swiss business for the project. The community of Gracias a Dios was one of those included in the rainwater harvesting and health components and six of the fourteen rainwater harvesting systems that were built are in this community. The systems consist of large ferrocement tanks filled by gutters from the roofs of houses. The capacity of a tank for an average sized family was 27,000 litres based on calculations projecting how much water would need to be stored to last throughout the dry season. On completion of the tanks, the quality and use of the water were monitored to evaluate the success of the project and to determine whether modifications should be made to the design for future projects. The final project cost was \$86,301 and details of the project are available at [www.nuevasesperanzas.org](http://www.nuevasesperanzas.org) including the final report which can be downloaded in full.

The project was very successful and the systems continue to work well. The chemical and microbiological quality of the water has been analysed and is considered to be very good. Most tanks have shown no indication of faecal contamination whatsoever, and those which did contain the indicator bacteria, *E. Coli*, had levels well below those that are typical for rural water supplies from wells, for example. However, the tanks are arguably slightly larger than is necessary. The capacity was based on a calculation which assumed that the users would ration their water to last throughout the dry season, ensuring that the tanks are full at the end of each wet season. In reality, however, it was found that they tend to use more water when it is available rather than allowing the tanks to fill, in the knowledge that they may not have sufficient water to last through the dry season. It is recommended that future tanks are constructed somewhat smaller, to avoid wastage in the cost of materials.

Following the successful pilot project in San Jacinto, Nuevas Esperanzas (taking over the projects after Mercy Ships closed its operations in Nicaragua in October 2005) has successfully

implemented two more rainwater harvesting projects in San Jacinto. One was working with the four churches to build systems to harvest water from their roofs, in the process building fellowship and harmony between believers of different denominations. This project was financed by various churches in the UK and had a total budget of \$24,949. The other project was in the hillside community of El Ojochal del Listón, a two hour horse ride from San Jacinto where a single 71,000 litre tank was constructed at a small school, for a total cost of \$6,510. Both these projects have been successfully completed and there are now 19 rainwater harvesting systems in operation in and around San Jacinto.

### *Community issues*

When Mercy Ships Nicaragua first became involved with the community of Gracias a Dios, it became clear that water was the issue that most concerned them. They held the perception that the only solution was a well and that this would have to be provided for them by an external donor as they would be unable to fund such a project themselves. Through the pilot project, Mercy Ships Nicaragua tried to empower the community to look for solutions that are more accessible. The concept of rainwater harvesting was received with interest but suspicion, but without visible examples of such systems in the community, they were unable to visualise how this could work for them. During the project, the participating households were expected to contribute the manual labour required to build the tanks with 100% of the cost of materials covered by Mercy Ships Nicaragua. Community organisation and participation was, at times, a challenge and progress was slower than anticipated. However, now that the tanks are built and in operation, the benefits can be seen and understood more clearly and there is a keen interest from those still without water, to build systems of their own.

### *Pipeline project*

While Nuevas Esperanzas had been building rainwater harvesting systems, a parallel project has also been developed by the *Alcaldia* in Telica to install a new borehole, electrical installation and pipeline to boost the existing header tank and water distribution system which is connected to, but was previously rarely able to supply, yard taps in parts of San Jacinto such as Gracias a Dios. The \$100,000 project was financed by CARE, World Vision and the *Alcaldia*. The emphasis of the pipeline project was on increasing the capacity of the water source, not on improving the distribution system. Previously, water was pumped from a spring, known as *El Chorro*, to a header tank on the south side of the main road. This header tank then provided water by gravity to the distribution system. Instead of using the spring, the system now uses a borehole located approximately 5 km east of the header tank with a substantial pipeline to deliver water up the hill to the tank. No changes were made to the header tank or distribution system.

In the design stage of this project, Nuevas Esperanzas reviewed the proposal and undertook a small investigation to determine the extent to which the proposed investment in the existing system would improve access to water in Gracias a Dios. The problem for Gracias a Dios is that it is located about 2 km west of the header tank, with the highest house in the community around the same elevation as the tank itself. Although the distribution system was installed for the whole community, it was fairly clear that water was unlikely to reach the highest parts of the network, especially when friction losses and the inevitable leaks along the 2 km of network are taken into account. What was not clear, however, was how much, if any, of the Gracias a Dios would benefit from the new system, as some parts of the community are at a lower elevation. At this point, Nuevas Esperanzas once again advised OBMM to retain their funds and await the outcome of the new pipeline.

Many technical problems were encountered during this project and for four months, San Jacinto had no piped water supply at all after the electrical installations had been moved from the previous source and before the pump was successfully installed in the new borehole. During this time all 3000 people from San Jacinto were travelling to collect water, either from springs or from the rainwater harvesting systems installed by Nuevas Esperanzas in the health centre, school and churches. The technical problems with the borehole pump and pipeline were finally resolved during the wet season of 2006 and the system has now been operational for the whole of the last dry season (2006/7). There were some further complications with the start of the repairs to the main road as the new water main which runs alongside the road was cut by workmen widening the road on a number of occasions.

### *Residual needs at Gracias a Dios and proposal for additional rainwater harvesting*

As was previously predicted, the investment in the existing system, which has been of considerable benefit to the majority of San Jacinto, has failed to provide water to the highest parts of the network in Gracias a Dios. In May 2007, Nuevas Esperanzas undertook a survey of Gracias a Dios to evaluate exactly how many houses are still without running water. There is a certain amount of discontent in this community about the new project since those that are fortunate enough to receive water have access to a only few hours' supply every day and a half, whilst most have no access at all. Each family which receives water is charged C\$50/month. Those who do not receive water at their houses and walk up to 250 metres to collect water from the parts of the network where it is available are charged C\$25/month.

The survey undertaken in May 2007 concluded that of the 70 houses in Gracias a Dios, only 22 have running water. Of the 48 which do not have water, 17 are located within 100 m of the houses which do have water and 3 of these already have rainwater harvesting systems from the project in 2005. Whilst rainwater harvesting could benefit these families, their need should not be considered as great as those which are more distant, and a more appropriate solution for these families could be the installation of public standpipes in the network from which they can collect water relatively close to their houses.

Of the 31 houses located more than 100 m from access to water, 2 already have rainwater harvesting systems, 3 are abandoned, 2 have only one or two people living in them and 3 are very small champitas with insufficient roof area for rainwater harvesting. This leaves 21 houses which could benefit greatly from rainwater harvesting. Of these 21 families, there are three pairs of adjacent houses which could share water tanks, channelling water from both roofs to fill the tank. This is recommended only where the option of sharing is both technically advisable in view of the small areas of roof *and* where it is unlikely to cause conflict. In all cases the families who would share are part of the same extended families (mother and daughter, two sisters, etc). This means that 18 rainwater harvesting systems would be sufficient to provide for the needs of 21 families, made up of 108 people in total. The distribution of these houses and access to the network is shown on this image of Gracias a Dios (courtesy of Google Earth) with information on each proposed tank given in the table below:



No. on map	Names	Number of family members	Roof area (m <sup>2</sup> )	Recommended tank capacity (litres)	Number of times tank could be filled each year	Cost of materials (US\$)	Water provided by system		
							Average (litres per person per day)	Dry season (l/p/d)	Average (barrels per month)
1	Jose Eduardo Vega Mayorga	6	52	23,000	3.2	1,335.00	33.2	25.6	37.9
2	Franklin Miranda	4	66	23,000	4.0	1,335.00	63.3	38.3	48.1
3	Petrona Bordas	4	36	16,000	3.2	1,165.00	34.5	26.7	26.3
4	Maria Elena Estrada	6	76	23,000	4.6	1,335.00	48.6	25.6	55.4
5	Lucrecia Garcias	3	45	23,000	4.3	1,335.00	53.7	30.7	32.8
	Luz Marina Moreno	2	25						
6	Martin Delgado	4	65	23,000	4.0	1,335.00	62.3	38.3	47.4
7	Antonio Munguia	4	64	23,000	3.9	1,335.00	61.4	38.3	46.7
8	Angela Barreras	4	61	23,000	3.7	1,335.00	58.5	38.3	44.5
9	Maria Magdalena Centeno	4	31	23,000	4.1	1,335.00	36.7	21.9	48.9
	Griselda Jacoba Centeno	3	36						
10	Mariana Bordas	10	60	23,000	3.7	1,335.00	23.0	15.3	43.8
11	Amparo Bordas	6	88	23,000	5.4	1,335.00	56.3	25.6	64.2
12	Soila Montes	5	36	16,000	3.2	1,165.00	27.6	21.3	26.3
13	Maria de la Cruz Centeno	8	66	23,000	4.9	1,335.00	28.2	13.9	48.1
	Gregoria Centeno	3	81						
14	Candido Montes	4	36	16,000	3.2	1,165.00	34.5	26.7	26.3
15	German Agustin Vargas Rios	7	66	23,000	4.0	1,335.00	36.2	21.9	48.1
16	Estela Ruiz	6	33	16,000	2.9	1,165.00	21.1	17.8	24.1
17	Jose Parrales	6	36	16,000	3.2	1,165.00	23.0	17.8	26.3
18	Uberlinda Vallesteros	9	70	23,000	4.3	1,335.00	29.8	17.0	51.0

**108**

**23,180.00**

The table above shows the proposed beneficiary families together with a recommended size of tanks. Five sizes of tanks have previously been constructed in San Jacinto. The two largest, 71,000 litres and 50,000 litres, are for large public buildings only. Domestic models have been constructed at 31,000 litres, 27,000 litres and 14,000 litres. As noted above, the previously constructed systems (31,000 and 27,000 litres) are considered to be too large as although they were designed to fill and store water for the whole dry season, they have not been operated in this way. For future construction at Gracias a Dios, two new sizes are proposed: 23,000 litres and 16,000 litres. A design for the 16,000 litre tank is attached to this proposal. An important indicator in selecting the appropriate size of tank is the theoretical number of times the tank could be filled each year taking into account the total rainfall and the area of the roof. Tanks built in 2005 could generally be filled, in theory, two or three times. For this proposal it is recommended that a theoretical minimum of three should be used, giving smaller tank sizes in general. Ensuring the tanks are no larger than necessary will make the project as cost effective as possible. The amount of water available in theory, using average annual rainfall data, is also shown in the table.

### *Proposed implementation of the project*

Having assessed the residual water needs of Gracias a Dios, a recommendation was made to OBMM on the most appropriate use of the funds collected several years ago to benefit this community. It was recommended that these funds were put towards a rainwater harvesting project to benefit the 21 families in Gracias a Dios with the greatest needs as defined above. The outline budget for this project is as follows:

	<i>US\$</i>
Materials (18 systems)	23,180.00
Trained masons (acting as foremen)	
<i>6 masons for 16 weeks @ \$50/week</i>	4,800.00
Supervising Civil Engineer	
<i>4 days per week for 16 weeks @ \$188.40/week</i>	2,411.52
Community Coordinator	
<i>2 days per weeks for 16 weeks @ \$217.20/week</i>	1,390.08
Transport (Toyota pickup truck or 2 ton KIA truck)	
<i>3800 km @ \$0.25/km</i>	950.00
<i>Subtotal</i>	<i>32,731.60</i>
Indirect project costs	<u>4,909.74</u>
<b>Total</b>	<b><u>37,641.34</u></b>

All manual labour would be provided by beneficiary families

In July 2007, a grant of approximately \$20,000 for the project was approved by OBMM. This is sufficient to cover the construction of approximately 10 systems with some additional funding from Nuevas Esperanzas UK and construction began on the first 4 systems the same month. Additional funds are being sought from World Vision and CARE so that all 18 systems can be constructed.

### *Further information*

This proposal is intentionally presented as an outline without technical specifications, detailed budgets or comprehensive plans. All of these are available on request from:

Contact:

Dr Andrew Longley, Director

Address:

Nuevas Esperanzas UK  
Iglesia La Recolección  
1 c. al oeste, 20 vrs al norte  
Casa #306  
León  
Nicaragua

Mailing address:

Nuevas Esperanzas UK  
Apartado #400  
León  
Nicaragua

Tel: +505 311 6057

Fax: +505 311 1594

E-mail: [director@nuevasesperanzas.org](mailto:director@nuevasesperanzas.org)

Website: [www.nuevasesperanzas.org](http://www.nuevasesperanzas.org)

